

July 15, 1952

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2,603,218

STOPPER FOR FLASKS

Original Filed Sept. 1, 1948

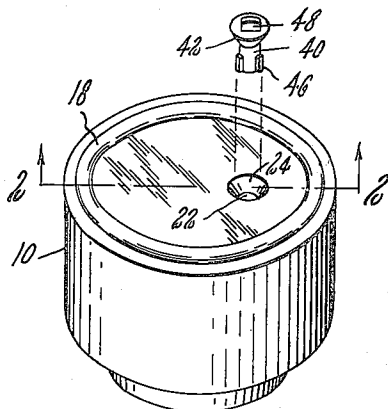


Fig. 1.

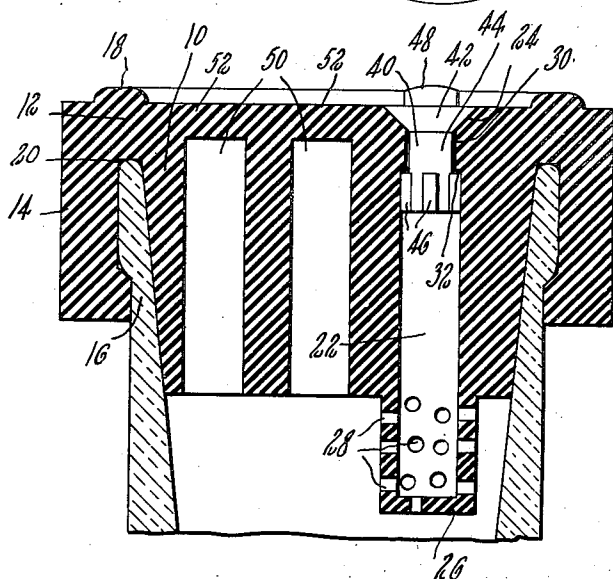


Fig. 2.

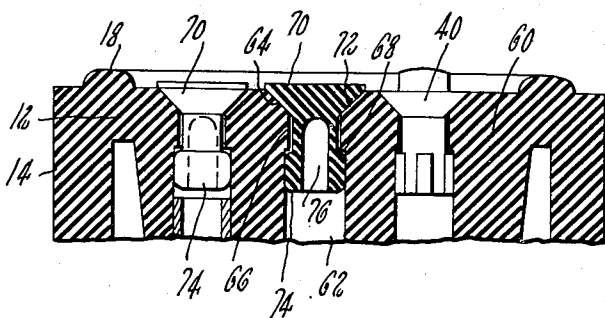


Fig. 3.

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UNITED STATES PATENT OFFICE

2,603,218

STOPPER FOR FLASKS

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Continuation of application Serial No. 47,181,
September 1, 1948. This application March 2,
1951, Serial No. 213,553

8 Claims. (Cl. 128-272)

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This application is a continuation of my co-
pending application, Serial No. 47,181, filed
September 1, 1948, and now abandoned. The in-
vention relates to a stopper adapted for use with
bottles or flasks such as are customarily em-
ployed in hospitals and elsewhere for medical
purposes. Large quantities of solutions of
sodium chloride, dextrose, and other crystalloids
are customarily used in hospitals and by the
armed services for the preservation of whole
blood and the preparation of blood plasma.
Such solutions must be bacteriologically sterile
and free from pyrogenic substances that cause
chill and fever reactions. Solutions of this kind
are sometimes prepared in hospitals or may be
purchased ready for use. When the solutions are
prepared in the hospitals, it is necessary that the
flasks or bottles be thoroughly sterilized with
their contents. This is done by enclosing the bot-
tles in an autoclave and heating the contents of
the autoclave to temperatures well above the boil-
ing point of the solutions, pressures greater than
atmospheric being necessary in the autoclave for
this purpose. During the sterilizing process, the
contents of the bottles are caused to boil. Con-
sequently, the usual practice is to leave a vent in
the stopper of each bottle to permit the escape of
vapor and to prevent pressure from building up
in the bottles in excess of that in the interior of
the autoclave. When the sterilizing process has
been completed, vapor is released from the auto-
clave to reduce the pressure therein to atmos-
pheric. The autoclave is opened at once and the
vents in the bottle stoppers are closed while the
bottles are hot. This requires prompt handling
of the bottles as soon as the autoclave is opened
since air will be drawn into the vent of any bot-
tle in which the temperature of the contents falls
below the boiling point before the vent is closed.
On the other hand, when the autoclave is first
opened, the contents of the bottles are still well
above the boiling point so that ebullition con-
tinues as the bottle and its contents start to cool.
This is apt to cause the stopper to blow out after
the vent is closed, or, if the stopper has been
firmly secured, to cause the bottle itself to ex-
plode. Hence, this process of sterilizing bottles
involves a definite, recognized safety hazard.

According to the present invention, a bottle
stopper with a simple, reliable check valve is
provided. When using the improved stopper in
bottles in the autoclave, it is merely necessary to
turn off the heat when the sterilizing has been
completed, leaving the autoclave and its contents
to cool to room temperature before the autoclave

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is opened. The condensation of vapor within the
autoclave during the cooling results in a vacuum
of the order of 26" to 28" in the autoclave and
in the bottles therein. In order to open the auto-
clave, air must be admitted to bring the pressure
therein up to atmospheric. If the check valves
in the bottle stoppers are properly operative and
reliable, the vacuum in the individual bottles will
be maintained when air is let into the autoclave;
otherwise, some of the air will seep past the valves
into the bottles and will not only destroy the
vacuum therein but will also nullify the steriliza-
tion of the contents. For reasons hereinafter set
forth, stoppers embodying the present invention
have been found to be reliable in maintaining the
maximum vacuum in bottles which have been
sterilized and cooled in an autoclave before the
latter is opened. According to the invention, the
stoppers which are preferably of soft vulcanized
rubber, are provided with valves, as hereinafter
described, which can yield slightly to permit the
escape of gas or vapor under pressure within
the bottle or flask but which are resiliently
pressed against the valve seats when the pres-
sures inside and outside of the bottles are
equalized so that when the outside pressure be-
gins to exceed the inside pressure, no air or vapor
is permitted to seep past the valves into the bot-
tles. In this way the high degree of vacuum
developed in the bottles in the autoclave during
the cooling period is retained when air is ad-
mitted into the autoclave.

For a more complete understanding of the in-
vention, reference may be had to the following
description thereof and to the drawing, of which:

Figure 1 is a perspective view of a stopper em-
bodying the invention;

Figure 2 is a sectional view of the same on
the line 2-2 of Figure 1; and

Figure 3 is a fragmentary sectional view of a
modified form of the invention.

The stopper illustrated in Figures 1 and 2 is
preferably made of suitable elastic material such
as soft vulcanized rubber. The body of the stop-
per 10 tapers downward slightly and is made with
an integral radial flange 12 from which depends
a skirt 14 adapted to surround the portion of the
bottle neck 16 adjacent to the mouth thereof.
On the upper surface of the stopper is a circular
ridge or rib 18 which is located directly above
the lip 20 of the bottle or flask when the stopper
is in place, the inner diameter of the rib 18 being
substantially equal to the maximum diameter of
the body portion of the stopper, as shown in
Figures 2 and 3. This provides extra thickness

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directly over the lip of the bottle and tends to prevent the stopper from being sucked too far into the neck of the bottle when the pressure inside is low.

The stopper is formed with a longitudinal duct or passage 22 having a flared orifice 24 at the upper end. Integrally molded with the body of the stopper is a tubular projection 26, the interior of which is a continuation of the duct 22. The projection 26 is closed at its lower end and is provided in its side walls and bottom wall with a number of openings 28 which are considerably smaller than the bore of the duct 22. The extension 26 thus serves as a screen or strainer to prevent the passage of particles from the interior of the bottle or flask into the duct 22 of such a size as might clog the duct. Since there are several holes 28 in the extension, the blocking of some of the holes by particles which may be in the bottle will not cut off the duct 22 from access by liquid in the bottle. This feature is of great practical importance in the use of the flask and stopper for supplying blood and other liquids to be introduced into a human body. In such cases, the flow of the liquid must not be interrupted by clogging of the duct 22.

The upper portion 30 of the duct 22 is preferably constricted for a short distance to form an annular shoulder 32 which serves to retain in place a tube (not shown) which may be inserted into the upper portion of the duct 22 when it is desired to drain fluid from the bottle or to introduce fluid therein. Such tubes are usually made of glass or metal with a somewhat bulbous extremity having a bulge which can catch under the shoulder 32 so as to prevent accidental withdrawal of the tube from the stopper. In order to provide a removable check valve and seal for the duct, a plug 40 is provided to be inserted in the upper portion thereof before the stopper is mounted in the mouth of a bottle or flask. This plug is preferably of soft vulcanized rubber but can be made of other materials such as a molded synthetic resin, metal or any suitable shape-retaining solid material. The plug 40 has a frusto-conical disc portion 42 which is adapted to fit into and seat in the flared orifice 24, the latter thus serving as a valve seat. The plug has a stem 44 below the disc 42, which is smaller in diameter than the duct so as to leave clearance between the stem and the wall of the duct. The lower portion of the stem is provided with a series of radial projections 46 which constitute an interrupted circumferential band having an outside diameter substantially equal to the diameter of the surrounding portion of the duct 22. The plug may also be provided with an upstanding finger tab 48 at its upper end which facilitates removal of the plug from the duct. The body of the stopper may also have one or more additional ducts 50 which extend longitudinally up from the bottom of the stopper body to a point near but spaced from the upper surface of the stopper by end walls 52. These ducts are adapted to receive hollow needles which may be thrust through the top of the stopper to pierce the end walls 52. The bottle or flask which has been properly sterilized usually carries a high degree of vacuum which sucks the end walls 52 inward to form shallow dimples in the top surface of the stopper directly above the ducts 50, making slight depressions in the top surface of the stopper. These depressions or dimples indicate where a hollow needle may be thrust into the stopper to penetrate into one of the ducts 50.

When a flask is to be sterilized with its con-

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tents, the stopper is prepared by the insertion of the plug 40 into the upper end of the duct 22 so that the valve portion 42 seats on the valve seat 24. The stopper is then thrust into the mouth of the bottle or flask until the flange 12 seats on the lip 20 of the bottle. As the stopper is pushed into the tapered throat of the bottle, the wedging action squeezes the body of the stopper inward. This tends to contract the bores of the ducts 22 and 50 so that the wall of the duct 22 which is in contact with the projections 46 grips such projections firmly. To sterilize the bottle and its contents, they are heated in a closed autoclave to a temperature well above that of the boiling point of water, this being made possible by raising the pressure within the autoclave to several pounds above the atmospheric. Whenever the pressure generated within the bottle or flask exceeds that just outside the bottle, the excess inner pressure is relieved by escape past the valve element 42 which is slightly lifted in the process. The lifting of the valve is resiliently opposed by the elasticity of the plug itself and of the duct wall which grips the lower portion of the plug. If the plug is of rigid material such as metal, it will yield resiliently by reason of the wall of the duct with which its lower end portion is in binding contact. As a result of the resilient holding of the valve 42, only a very slight yielding is necessary for the escape of gas or vapors from the interior of the bottle. When the pressures inside and outside of the bottle are equalized, the valve 42 is held firmly on its seat by resilient pull of the plug itself or of the walls of the duct which grip the projection 46 of the plug. It has been experimentally proven that a substantial mechanical pressure of the valve against its seat is necessary to prevent the seepage of gas or vapor past the valve and into the bottle when the pressure therein begins to drop below the pressure on the outer surface of the stopper. The resilient pull on the valve element 42 provides the necessary force to press the element on its seat, this pressing action being increasingly augmented when a substantial excess external pressure is built up, as when the pressure inside the bottle is diminished or the pressure outside the bottle is increased. The latter takes place, for example, when air is admitted to an autoclave after it and its contents have been heated to sterilize and then allowed to cool to a point where the pressure within the autoclave is below atmospheric.

Figure 3 shows a stopper 60 which is identical in construction with the stopper 10 except that the ducts 62 into which needles may be thrust are extended all the way through the body of the stopper instead of stopping short of the top surface as shown in Figure 2. The upper portion of each duct 62 is flared as at 64, a reduced portion 66 being formed for a short distance below the flared orifice so as to produce a shoulder 68. In each duct 62 is a plug 70, preferably of soft vulcanized rubber, the plug having a frusto-conical portion 72 at its upper end adapted to fit the flared orifice 64. The plug 70 has on its lower portion 74 a flange of sufficient diameter to fit against the wall of the duct 62 below the shoulder 68. Each plug also has a central bore 76 projecting out from the lower end to a point spaced from the upper end of the plug. A hollow needle may be thrust in through the head of the plug to penetrate into the bore 76 or to continue on down into the duct 62 below the plug. The heads of the plugs 70 indicate where a needle can be thrust inward to penetrate into one of the ducts

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62. When a plug 70 has been punctured, it can later be replaced by a new plug of the same kind, thus avoiding possible leakage through the puncture in subsequent use of the stopper.

I claim:

1. A stopper member having a tapering body portion adapted to wedge into the mouth of a flask or the like, said stopper member having a longitudinal duct therethrough with a valve seat around the upper end of said duct, and a valve member in said duct having a disc portion normally pressing on said seat and a portion in binding engagement with the wall of the duct at points spaced below said seat, at least one of said members being of resilient material whereby said disc portion of the valve member is resiliently drawn back by elastic force when displaced from said seat to permit the escape of fluid under pressure in said duct.

2. A stopper of resilient material having a tapering body portion adapted to wedge into the mouth of a flask or the like, said stopper having a longitudinal duct therethrough with a valve seat around the upper end of said duct, and a valve member in said duct comprising a disc normally engaging said seat, a stem extending from said disc in said duct and of smaller diameter than the surrounding portion of the duct, and a plurality of lugs projecting radially from a portion of the stem spaced from said disc, said lugs bearing against the wall of said duct.

3. A stopper of resilient material having a tapering body portion adapted to wedge into the mouth of a flask or the like, said stopper having a longitudinal duct therethrough with a frusto-conical valve seat at its upper end, and a valve member of resilient material in said duct, said valve member comprising a frusto-conical disc normally pressed against said seat, a stem extending downward from said disc, and a plurality of radial projections on said stem in binding engagement with the wall of said duct and spaced below said disc.

4. A stopper as in claim 3, said stopper also having a strainer at the lower end of said duct with a plurality of holes each of which is materially smaller than the cross-section of the duct.

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5. A stopper as in claim 3, said stopper having a hollow extension projecting from the lower end thereof and integral therewith, said extension having a plurality of holes therethrough, each substantially smaller than the cross-section of the duct and communicating with the duct.

6. A stopper as in claim 3, said stopper also having a skirt spaced outward from said body portion to engage and cover a substantial portion of the exterior surface of the flask adjacent to the mouth thereof, a circular upstanding rib on top of said stopper and integral therewith, the inner diameter of the rib being substantially equal to the maximum diameter of the tapered body portion of the stopper.

7. A stopper as in claim 3, said stopper also having a plurality of bores extending up from the lower end thereof nearly to the top thereof, said bores being closed at their upper end.

8. A soft vulcanized rubber stopper for a flask or bottle, said stopper having a tapering body portion with a longitudinal duct extending therethrough, an integral radial flange at its upper end, a skirt depending from said flange and adapted to embrace a portion of a bottle neck, and a circular rib on the upper face of said flange, said duct having a frusto-conical orifice at its upper end and a perforated straining device at its lower end integral with the body of the stopper, and a soft rubber plug in the upper portion of said duct, said plug having a frusto-conical valve part seated in said orifice, a stem of smaller diameter than the duct, and radial projections on its lower portion in binding engagement with the wall of the duct when the stopper is in use.

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